

Sherman Lam (sherman1)
Logan Ellis (logane)
Jack Buffington (jbuffing)
16720 CV
October 12, 2016

3D Scene Reconstruction from Single Moving Camera

1 Project Overview

3D scene reconstruction is useful in robotics for understanding a robot's environment can aid in navigation through this environment. One typical approach is to use a combination of a GPS, laser scanners, and inertial measurement units to generate a map of the environment. However, this requires extensive, expensive, and specialized hardware. We would like to reconstruct a scene using video recorded from a standard cell phone camera.

The goal of this project is to reconstruct a 3D scene using video recorded from a standard cell phone camera. This project will attempt to recreate the work of Newcombe and Davison ([8]). They present an algorithm that efficiently generates a dense model of a camera scene. It leverages a structure from motion algorithm called "Parallel Tracking and Mapping" (PTAM) to extract a high density of keypoints from each frame of the video feed. Their algorithm uses these points to first construct a low resolution model of the environment. Using groups of camera views with overlapping surface visibility, the model coarse model is refined to yield a dense depth map. Once this depth map is created for various scenes in the environment, the individual depth maps are stitched together to create a 3D map of the entire environment.

Other papers that address similar problems and which we may refer to include [8], [1], [4], [9], [5], [6], [3], [7], and [2].

2 Timeline

How much time do have for this? The online calendar isn't clear...

Are we expected to start working on the project after HW5 is due or before? If after, we have like no time to work on this.

References

- [1] Andrew J Davison. Real-time simultaneous localisation and mapping with a single camera. In *Computer Vision, 2003. Proceedings. Ninth IEEE International Conference on*, pages 1403–1410. IEEE, 2003.
- [2] Andrew J Davison, Ian D Reid, Nicholas D Molton, and Olivier Stasse. Monoslam: Real-time single camera slam. *IEEE transactions on pattern analysis and machine intelligence*, 29(6):1052–1067, 2007.
- [3] Andreas Geiger, Julius Ziegler, and Christoph Stiller. Stereoscan: Dense 3d reconstruction in real-time. In *Intelligent Vehicles Symposium (IV), 2011 IEEE*, pages 963–968. IEEE, 2011.
- [4] Georg Klein and David Murray. Parallel tracking and mapping for small ar workspaces. In *Mixed and Augmented Reality, 2007. ISMAR 2007. 6th IEEE and ACM International Symposium on*, pages 225–234. IEEE, 2007.
- [5] Annika Kuhl, Christian Wöhler, Lars Krüger, Pablo dAngelo, and Horst-Michael Groß. Monocular 3d scene reconstruction at absolute scales by combination of geometric and real-aperture methods. In *Joint Pattern Recognition Symposium*, pages 607–616. Springer, 2006.
- [6] Daniel Magree, John G Mooney, and Eric N Johnson. Monocular visual mapping for obstacle avoidance on uavs. *Journal of Intelligent & Robotic Systems*, 74(1-2):17–26, 2014.
- [7] Philip F McLauchlan. A batch/recursive algorithm for 3d scene reconstruction. In *Computer Vision and Pattern Recognition, 2000. Proceedings. IEEE Conference on*, volume 2, pages 738–743. IEEE, 2000.
- [8] Richard A Newcombe and Andrew J Davison. Live dense reconstruction with a single moving camera. In *Computer Vision and Pattern Recognition (CVPR), 2010 IEEE Conference on*, pages 1498–1505. IEEE, 2010.
- [9] Marc Pollefeys, David Nistér, J-M Frahm, Amir Akbarzadeh, Philippos Mordohai, Brian Clipp, Chris Engels, David Gallup, S-J Kim, Paul Merrell, et al. Detailed real-time urban 3d reconstruction from video. *International Journal of Computer Vision*, 78(2-3):143–167, 2008.